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AUTHOR Cox, Gloria; Paris, Scott
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ABSTRACT

Three research studies were performed to assess patterns of memory organization with respect to complementary and similarity dimensions, referring to associations based on functional relatedness and grammatical relatedness, respectively. The first study failed to replicate the results of a study by Denney and Ziobrowski (1972), indicating that there is a complementary-similarity shift with age in the bases of memory organization. In the second study, two lists of target items and cues representing complementary and similarity relationships were constructed and presented verbally to third graders, sixth graders, and college students. The results of this experiment indicated that complementary and similarity did not represent unique dimensions that were used differentially. Subjects of all ages were using similarity cues better in accessing recall. In the third experiment, preference for clustering dimensions was assessed for the same age groups using complementary and similarity relationships as a within-list effect. No evidence was found for any age group to indicate that one dimension was spontaneously chosen or preferred over the other dimension in forming clusters during free recall. It was concluded that a complementary-similarity shift in bases of memory organization with age is unlikely. (MKM)

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Developmental Changes in the Salience of Encoding Dimensions

Gloria Cox and Scott Paris

Purdue University

Today we want to present the results of some of our research concerning developmental changes in memory organization. Specifically, we shall consider the following question: Do 'complementary' and 'similarity' associations form different organizational bases for encoding for children and for adults? Our findings indicate that they do not. Furthermore, we believe that these studies challenge the notion that associative criteria are even used normatively as encoding dimensions by either children or adults.

A study conducted by Denney & Ziobrowski (1972) served as the basis of our research. They measured children's and adults' clustering on two different categorized lists. One list consisted of word pairs which were complementary associates (needle-sew) and the other list consisted of word pairs which were similarity associates (king-ruler). The terms complementary and similarity refer to associations based on functional relatedness and grammatical relatedness, respectively. It has been well documented that these dimensions are used differently by children and adults as categorizing criteria (Brown & Berko, 1960; Ervin, 1961). Denney and Ziobrowski (1972) concluded that these dimensions were used differentially to organize information for memory as well. In their experiment, first graders' clustering was significantly higher on the complementary list than on the similarity list and the reverse was true of college students' clustering. Denney and Ziobrowski (1972) concluded that there was a complementary-similarity shift with age in the bases of memory organization.

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We tried to correct a floor effect and replicate Denney and Ziobrowski's (1972) results with their own word lists and similar procedures, but failed. A careful analysis of our data and theirs indicated that the measure of clustering used in the original study (Cole, Frankel & Sharp's, 1971 Z-score) was not appropriate with low levels of recall and small category size. We concluded that this particular paradigm may not be sensitive to organizational differences in memory and that a better method was needed.

What method did we use? In our second study, we employed Tulving & Watkins' (1975) cued recall paradigm to assess patterns of memory organization with respect to complementary and similarity dimensions. Time does not permit us to describe this paradigm in detail, so let me give you a brief overview. Pretend you are a subject for this experiment. First I would ask you to remember a list of words--Coffee, Bicycle, Shovel, Hen, Photo, Thief, Sad, Rock. Then, I would give you several cues for the words on the list--Drink, Ride, Happy, Stone, Tea, Wagon and you would be asked to respond with the appropriate target item. The trick is that two cues are given for every target. For example, in the list I just read, Coffee was probed by Drink and by Tea. The advantage of this paradigm is that the relative effectiveness of two cueing dimensions may be compared directly, for the same target words within the same subjects. Patterns of recall are described by tabulating the number of words recalled to only one cue, to both cues and to neither cue and then converting these numbers to valences which represent the proportion of the 'memory trace' accounted for by each of these cells.

We constructed two lists of target items and cues representing complementary and similarity relationships and presented them verbally to third-graders, sixth-graders, and college students. These lists appear in Table 1. Presentation of target words was followed by a three-minute interpolated task. Sixteen cues

were then presented for each list. Eight of the cues represented the complementary dimension and eight represented the similarity dimension. The order of cue presentation was balanced so that complementary cues preceded and followed similarity cues for the same items an equal number of times and so that the position of cues within the total list of 16 was varied.

What did we find? In Table 2, the average valences of recall are shown for each age group, with the data combined across lists. The reduced valences represent the proportion of target items recalled uniquely to each of the cue dimensions. The common valence represents the proportion of target items recalled twice, in the presence of both cues. Finally, the valence not-complementary-not-similarity represents the proportion of items not recalled to either cue.

The results of interest in this analysis are the similar patterns of reduced valences and the high common valences across all age levels. This finding indicates that complementary and similarity did not represent unique dimensions that were used differentially. Clearly, subjects of all ages were using similarity cues better in accessing recall. However, the pattern of cue effectiveness did not vary with age. The percentages of words recalled to each type of cue are shown in Figure 1 and support this conclusion.

Summarizing Experiment 2, we used a new paradigm to descriptively assess patterns of memory organization and found no differences with age in the usage of complementary and similarity dimensions to aid recall. Our results clearly indicate no differences across age levels in the ability to use these associative dimensions.

It is conceivable that children and adults may prefer to use complementary and similarity dimensions differentially in the organization of information for recall, and that this difference in preferences did not reveal itself on the cued recall task. In Experiment 3, we tried to answer this question by using a

free recall paradigm which allowed us to assess preference for clustering dimensions contained within the same list. We constructed two 24-item lists for this task using all of the target items and cues from the list in Experiment 2. Each list contained eight three-item categories consisting of a target word, a complementary associate, and a similarity associate. Needle-thread-sew, for example, constituted one of the experimenter-defined categories. We were interested in finding out whether subjects would cluster all three items from each category together in recall or whether their clusters would consist of pairs representing either a complementary or a similarity relationship (i.e., needle-sew vs. needle-pin).

These lists were given to third graders, sixth graders, and college students in a multitrial free recall paradigm. Each subject was given one list for four presentation-recall trials.

The results of this experiment were that both recall and clustering increased significantly across trials for all age groups. Children's increases in clustering were related to an increase in the use of pairs over trials while adults' increases in clustering were related to increases in the use of three-item clusters across trials. In Table 3, the proportion of recall accounted for on Trials 1 and 4 by single items, pairs, and triplets is presented for each age group. An Age x Cluster Size x Trials analysis of variance was performed on the proportions of words recalled and the observed difference in clustering patterns for different age groups (Age x Cluster Size interaction) was significant.

These results indicate that adults, at least, did not prefer one associative dimension over the other in clustering during free recall. What about children's preferences for complementary or similarity dimensions, since they increased clustering by recalling more pairs over trials? Recall of pairs was broken down into complementary pairs, and similarity pairs and sign tests were conducted

on the number of words recalled in each dimension over trials. The proportions are shown in Table 4. No significant differences were found between the number of complementary pairs and the number of similarity pairs on either Trial 1 or Trial 4 for any of the age groups.

Summarizing Experiment 3, preference for clustering dimensions was assessed for different age groups using complementary and similarity relationships as a within-list effect. No evidence was found for any age group to indicate that one dimension was spontaneously chosen or prefered over the other dimension in forming clusters during free recall It is possible that complementary and similarity dimensions may differ as categorizing criteria in sorting tasks or free association tasks, but there is little evidence that children use these dimensions differentially in order to organize memory.

What can we conclude from these studies? Conservatively, we can conclude that the existence of a complementary-similarity shift in bases of memory organization with age is unlikely. Both children and adults were able to use these dimensions with equal ease in these experiments. More broadly, our research challenges the notion that associative criteria are used as normative encoding dimensions. If children understand the stimuli and task requirements, they may show considerable flexibility in their production and use of organizational strategies (Lange & Jackson, 1974).

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Purdue University

Table 1

Experimental Lists for Cued Recall Task

List 1

Target	Complementary Cue	Similarity Cue
Hammer	Nail	Saw
Crib	Infant	Cradle
Float	Light	Sink
Open	Door	Close
Needle	Thread	Pin
Horse	Gallop	Pony
Apple	Core	Banana

List 2

Target	Complementary Cue	Similarity Cue
Coffee	Drink	Tea
Bicycle	Ride	Wagon
Shovel	Dig	Spade
Hen	Egg	Chicken
Photo	Camera	Portrait
Thief	Jail	Robber
Sad	Cry	Happy
Rock	Hard	Stone

Table 2

Reduction Matricies

	Grade 3	Grade 6	College
Reduced Valence Complementary	.09	.13	.14
Reduced Valence Similarity	.23	.22	.26
Common Valence	.24	.30	.29
Not Complementary-Not Similarity	.42	.35	.32

Figure 1

Percentage of Targets Recalled to Complementary Cues and Similarity Cues

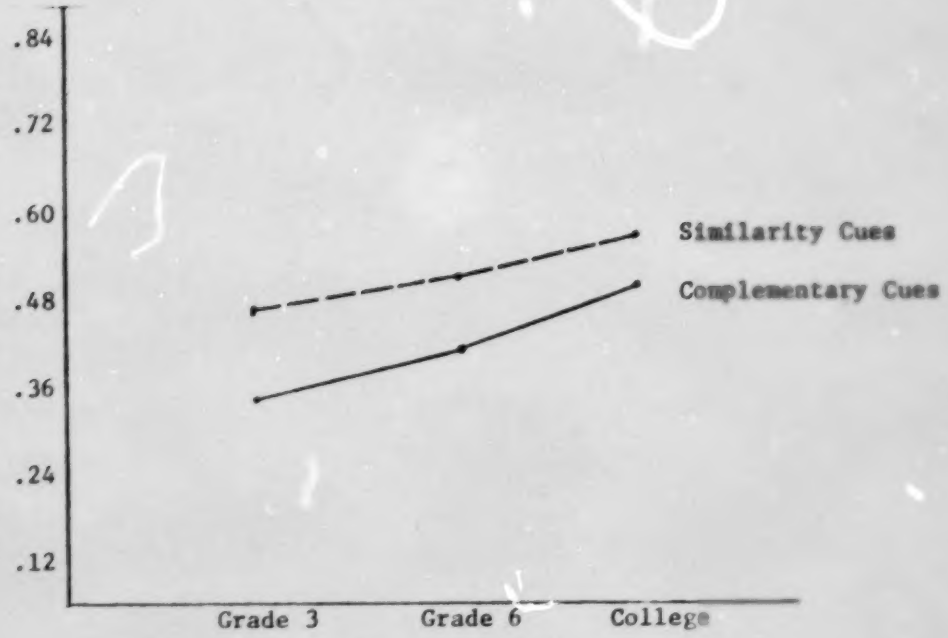

Table 3

Proportion of Recall Accounted for by

Single Items, Pairs, and Triplets

			Singles	Pairs	Triplets
3	Trial	1	.65	.29	.05
		4	.47	.38	.14
6	Trial	1	.52	.41	.06
		4	.40	.40	.19
College	Trial	1	.27	.39	.34
		4	.13	.17	.70

Table 4

Proportion of Recall Accounted for by Complementary

Pairs and Similarity Pairs

	Grade 3		Grade 6		College	
	Trial		Trial		Trial	
	1	4	1	4	1	4
Complementary	.07*	.05	.16	.15	.12	.04
Similarity	.06	.11	.20	.19	.14	.07

*Proportions are based on the number of words recalled on each trial.